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The effect of three-part breathing exercise on smoking cessation: A 6-month cluster-randomized clinical trial

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ABSTRACT

Introduction: Negative affect was identified as an important barrier to smoking cessation. Three-part breathing exercise showed a significant effect on decreasing negative affect immediately after being practiced. Thus, this study evaluated the effect of three-part breathing exercise on smoking cessation.
Methods: A 6-month cluster-randomized clinical trial was conducted. Forty-three participants recruited from 8 companies in Bangkok Metropolitan areas were randomly assigned at the cluster level into either the intervention or control groups. Control group (n = 23) received counseling for smoking cessation once a week for 12 weeks. Intervention group (n = 20) received counseling for smoking cessation plus a three-part breathing exercise program once a week for 12 weeks. The primary outcomes were 7-day point prevalence and continuous abstinence rate as validated by saliva cotinine. The secondary outcomes were cigarette cravings, nicotine withdrawal symptoms, affect and quality of life.
Results: The results revealed no significant difference in smoking abstinence rate between the three-part breathing exercise and control group. Participants demonstrated significant pre-post improvement in cigarette cravings, nicotine withdrawal symptoms, affect, and quality of life within each group.
Conclusion: There were no statistically significant differences between the two groups. However, the improvement in abstinence rate from the three-part breathing exercise was deemed clinically relevant. Thus, it may be recommended to smokers interested in smoking cessation and more research is needed on this topic.

1. Introduction

Tobacco use is the leading causes of preventable death. In each year, more than eight million people died due to tobacco. Of these deaths, about 1,200,000 died as the result of non-smokers being exposed to second-hand smoke (World Health Organization 2017). In addition, economic damage caused by smoking is estimated at 1,436 billion US dollar (equivalent in magnitude to 1.8% of the world's annual GDP) (Goodchild et al., 2018). Smoking cessation is one of the most effective ways of reducing mortality rate (Anthonisen et al., 2005; Kenfield et al., 2008) and addressing these economic costs.

In the present, the combination between counseling and pharmacotherapy is considered an effective treatment for smoking cessation (U.S. Department of Health and Human Services 2008). However, a number of side effects have been reported with pharmacotherapy; including insomnia, dry mouth, seizures, nausea and dyspepsia (U.S. Department of Health and Human Services 2008). Thus, alternative smoking cessation programs are needed to support individual who would like to quit smoking without pharmacotherapy. A systematic review revealed no effect of aerobic exercise, resisted exercise, physical activity and combined aerobic and resisted exercise on smoking cessation (Klinsophon et al., 2017c). However, there was a positive effect of yoga on smoking cessation at the end of treatment (Klinsophon et al., 2017c). Yoga differs from the other exercise types because it incorporates breathing exercises and meditative components in addition to bodily exercise (Bock et al., 2012). The breathing exercises and meditative components have a positive effect in several ways such as stress, anxiety and depression reduction (Brown and Gerbarg 2005; Lane et al., 2007; Manocha et al., 2011; Moss et al., 2012; Sharma et al., 2013). However, a systematic review revealed that mindfulness meditation did not have significant effects on abstinence rate, relative to comparator groups (Maglione et al., 2017).

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Thus, the positive effect of yoga on the smoking cessation rate may result from the combination effect of all components of yoga or breathing exercise alone.

Taking deep breaths is one of non-pharmacotherapy techniques has been recommended as a potential strategy to cope with nicotine withdrawal symptoms and to relieve stress in smokers who would like to stop smoking (World Health Organization 2014). This technique is easy to perform and smokers can perform by themselves without any charge. Previous researches revealed that breathing exercise significantly reduce cigarette craving and negative affect immediately after it was practiced (Klinsophon et al., 2020; Lotfalian et al., 2020; McClernon et al., 2004; Shahab et al., 2013). In addition, a previous study showed that participants smoked fewer cigarettes in the 24 h following the breathing exercise manipulation (Lotfalian et al., 2020). Furthermore, another study found that 21% of participants practicing breathing exercises reported that they stopped smoking at 6-month follow-up (Kochupillai et al., 2005). It has been hypothesized that breathing exercises may reduce cigarette craving and negative affect via the autonomic nervous system (ANS) (Shahab et al., 2013). Evidence suggested that practicing slow breathing exercises resulted in an increase in parasympathetic activity (Pal et al., 2004). Furthermore, slow breathing appeared to reduce anxiety and increase parasympathetic activity (Wells et al., 2012). In addition, distraction and focused attention on inhalation and exhalation while performing breathing exercises are also proposed as possible mechanisms (Shahab et al., 2013). Several types of breathing exercise have been studied including three-part breathing exercise which showed a significance effect on decreasing negative affect immediately after it was practiced (Klinsophon et al., 2020). The three-part breathing exercise is slow deep breathing involving different body parts. It consists of three different breathing tasks which require the individual's attention on different parts of their body including the abdomen, lower costal and upper costal. Hence, performing the three-part breathing exercise seems to require more concentration and attention than the general breathing approaches. Negative affect plays a role underlying smoking motivation (Brandon 1994). Smokers tend to use tobacco to cope with negative affect (Brandon 1994). In addition, during smoking cessation, negative affect has been shown to promote smoking relapse (Piasecki et al., 2000; Shiffman and Waters 2004; Zuo et al., 2017). Negative affect may be considered an important barrier to smoking cessation. So, providing a strategy that is able to cope with negative affect could potentially facilitate smoking cessation success. Taken all together, whether three-part breathing exercises that alleviate negative affect improves smoking abstinence rate. To date, there has been no study examined the effect of three-part breathing exercise on smoking abstinence rate. Thus, the primary aim of the present study was to evaluate the effect of three-part breathing exercises on smoking abstinence rate.

2. Methods

2.1. Study population and procedures

A cluster randomized clinical trial with 6-month follow-up was conducted in a convenience sample of smokers recruited from 8 companies in Bangkok Metropolitan areas. Convenience participating companies were four each of government office and industrial factory. A self-administered questionnaire was used to screen potential participants for the study. Individuals were included if they aged between 18 and 60 years, smoked regularly for at least 1 year, interested in quitting, were of mild to moderate nicotine dependence level as assessed by the Thai version of the Fagerstrom Test for Nicotine Dependence or FTND (Klinsophon et al., 2017b) and had not been diagnosed with a serious health condition (e.g., cancer, heart disease, or asthma). Participants were excluded if they were undergoing any smoking cessation program, receiving any form of psychiatric treatment, unable to perform the three-part breathing exercise, and unable to set a quit date within 2 weeks after start the program. Participants were randomly assigned at the cluster level into either the intervention or control groups. Random allocation was performed using computer-generated randomization software (www.randomization.org) and concealed in an opaque envelope by researcher. Clusters of participants were located in the same companies to avoid contamination of the intervention and to enhance compliance within the three-part breathing exercise group. Participants in the control group received counseling for smoking cessation once a week for 12 weeks. Participants in the intervention group received counseling for smoking cessation once a week plus the three-part breathing exercise program for 12 weeks (Fig. 1). Text-message was sent to participants in the three-part breathing exercise group every day for 12 weeks to encourage their breathing exercise and record in a dairy.

Upon the beginning of the program (week 1), participants were assessed demographic variables, smoking history and score of intention to quit (1 item for a 10-cm visual analog scale). Cigarette cravings, nicotine withdrawal symptoms, affect and quality of life were assessed using self-reported questionnaire. The following week (week 2–11), participants were assessed cigarette cravings, nicotine withdrawal symptoms, affect and smoking status. Self-report of smoking status was verified by carbon monoxide concentration in expired air less than 10 ppm using the piCO+™ Smokerlyzer® (Bedfont Scientific Ltd., Kent, England). Measurement of carbon monoxide concentration in expired air was recorded by blinded researcher (counselor who performed smoking cessation counseling). The last week (week 12), cigarette cravings, nicotine withdrawal symptoms, affect, and quality of life were assessed. Self-report of smoking status which was verified by saliva cotinine was also assessed. Cigarette cravings, nicotine withdrawal symptoms, affect, quality of life and self-report of smoking status (verified by saliva cotinine) were assessed once again at the 24-week follow-up. Measurement of saliva cotinine was performed by blinded medical technologist.

This study, approved by the Ethic Review Committee for Research Involving Human Projects (COA No. 129/2017), is in accordance with the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study. This study was registered on the Thai Clinical Trials Registry (TCTR registration No. TCTR20170719003).

3. Interventions description

3.1. Counseling for smoking cessation

An individual-based counseling for smoking cessation was conducted by blinded counselor who had trained in conducting counseling for smoking cessation. The counseling sessions were conducted once a week for 12 weeks. Topics included basic information about smoking, identify high risk situation, develop coping skill and encouraging.

3.2. Three-part breathing exercise program

In the first session, participants were taught and then practiced the three-part breathing exercise in a comfortable sitting position under the supervision of physical therapist until they could perform them correctly. Participants were instructed to do the three-part breathing exercise for 10 min when they experienced craving. If participants didn't experience craving, they were asked

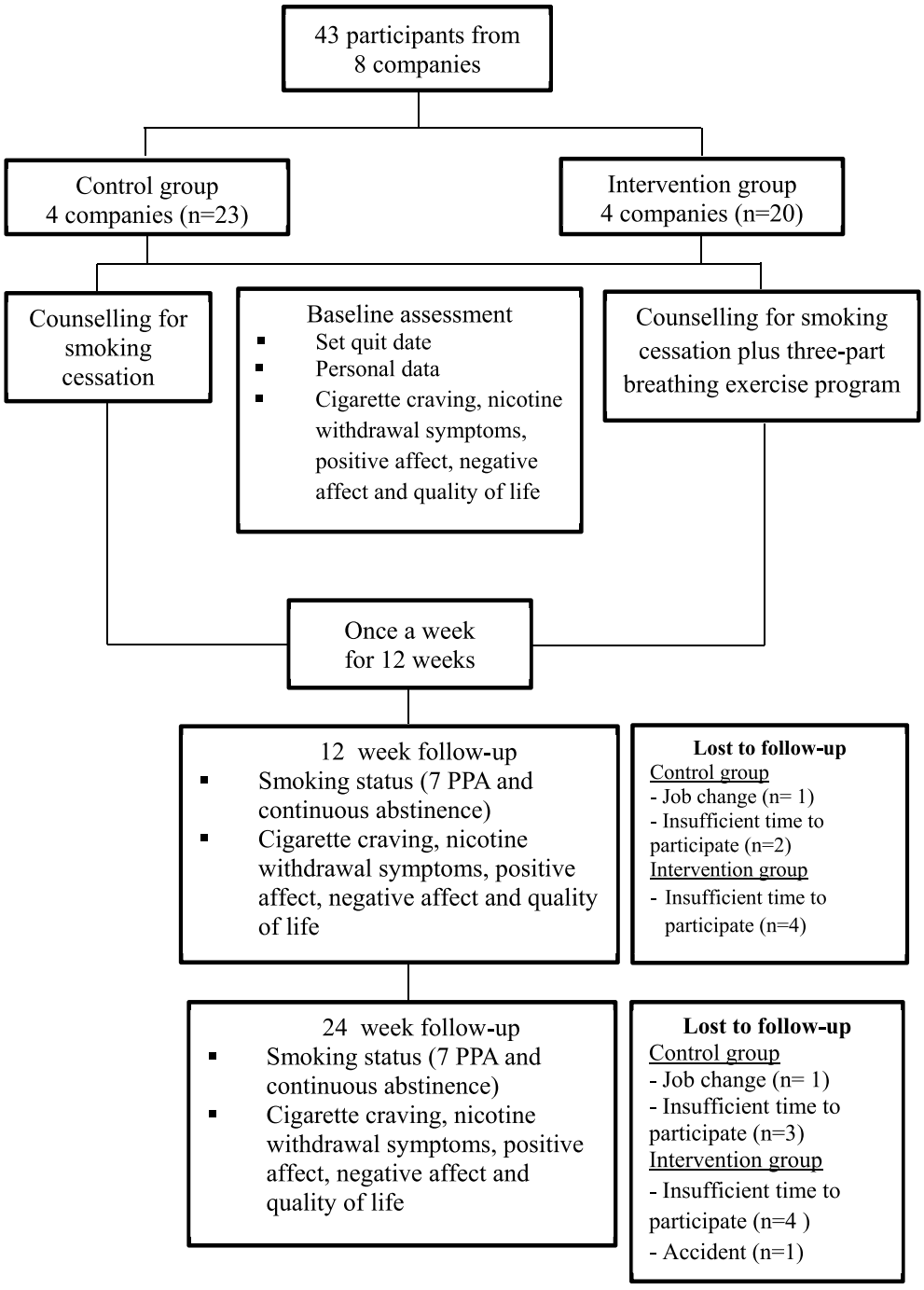

Fig. 1. Flow chart of the study.

to perform the breathing exercise at least 4 times (after waking up and 3 times after meals or at any convenient time) a day for 12 weeks. In addition, they were informed to stop the breathing exercise if they felt dizzy. Once the dizziness had disappeared, they continued the breathing exercise program. Participants were asked to record number of exercise session in a diary which is provided by researcher. Breathing exercise was re-examined and corrected every week by physical therapist.

Participant were asked to do the three-part breathing exercise in a comfortable sitting position as follows; for the first part, they were asked to breathe deeply until the abdomen moved forward for five breaths. For the second part, they were asked to breathe deeply until the lower costal (below nipple line) expanded for five breaths. In the third part, they were asked to breathe until the upper costal (above nipple line) moved upward for five breaths. Participants were allowed to rest 30 s between parts and repeat from the first part to third part for 10 min.

3.3. Outcomes measurement

3.3.1. Primary outcome

Smoking abstinence rate including 1) 7-day point prevalence abstinence at the end of treatment and follow-up period and 2) continuous abstinence from quit date through the end of treatment

and follow-up period. Both outcome variables were verified by saliva cotinine level less than 15 ng/mL (West et al. 2005).

3.3.2. Secondary outcomes

Secondary outcomes which included of cigarette craving, nicotine withdrawal symptoms, affect, quality of life and level of satisfaction were assessed by self-reported questionnaire. In addition, exercise adherence was reached from diary which number of exercise session was recorded by participants.

The mood and physical symptoms scale was used to assess cigarette craving and nicotine withdrawal symptoms (West and Hajek 2004). This scale was translated into Thai for this study using a cross-cultural adaptation process. The ICC $_{(3,1)}$ of total score of 5 core items (nicotine withdrawal symptoms) and total score of 2 items (cigarette craving) was 0.78 and 0.73, respectively.

Affect was assessed by the 20-item positive and negative affect schedule (PANAS) (Watson et al., 1988). This questionnaire has been translated into Thai (Klinsophon et al., 2017a). The ICC $_{(3,1)}$ of PANAS in Thai has been found to be 0.90 for positive affect and 0.93 for negative affect (Klinsophon et al., 2017a).

Quality of life was assessed by the Short-Form Questionnaire-Thai (SF-36) (Leurmarnkul W & Meetam P 2005). The 3 important domains which were impacted by smoking status (i.e., Physical function, general health and mental health) (Laaksonen et al., 2006) were assessed at the beginning of studying, end of treatment (week 12) and follow-up period (week 24).

Participants in the three-part breathing exercise group were asked to rate their breathing program satisfaction by using 10-cm visual analog scale at the end of treatment (week 12). Where 0 on the scale denotes not satisfy and 10 denotes extremely satisfy.

3.3.3. Statistical analysis

Sample size calculation was based on the previous study which demonstrated the smoking cessation rate at the 8-week follow-up to be around 13% in the control group and around 40.6% in the yoga group (Bock et al., 2012). We assumed an α error of 5% and targeted a statistical power of 80%. In addition, the drop-out rate was expected to be 10%. Forty participants were to be included in each arm of the study to account for these assumptions.

A Shapiro-Wilk test was conducted to ensure that the distributions of the study variables met the assumptions of normality for the planned parametric tests. Baseline demographic, smoking and other measured variables were examined for group differences using independent sample *t*-test or Chi-square test depending on the variable characteristics.

Intention-to-treat approach was carried out. Participants who were missing at the follow-up are assumed to be smoking. A chi-squared test was employed to determine the group difference on abstinence rate. Cigarette craving, nicotine withdrawal symptoms, affect and quality of life were analyzed using two-way analysis of variance (ANOVA) for repeated measures. Missing value of these outcomes was replaced with the most recent present value prior to it (Last observation carried forward). The least significant difference was used for post-hoc analysis. The level of significance was set at 0.05 for all statistical analyses. Data were analyzed using SPSS for Windows version 22 (IBM, USA).

4. Results

4.1. Participants

Forty-three smokers from 8 companies in Bangkok Metropolitan area were included in this study. At the end of follow-up, 9 dropped out of the study and the reason given for dropping out was job change (n = 1), accident (n = 1) and insufficient time to participate the study (n = 7) (Fig. 1). Table 1 shows the baseline characteristics of the participants in both groups. There were no significant baseline differences between participants randomized to the intervention versus control group. Individuals randomized to the three-part breathing exercise group performed an average of 68.0% of the full breathing exercise program.

4.2. Primary outcome

There was no significant difference in 7 PPA and continuous abstinence as verified by saliva cotinine between control and intervention group at the end of treatment (OR, 1.86; 95% CI 0.28–12.39; $p = 0.65$; and OR, 3.88; 95% CI 0.37–40.71; $p = 0.32$, respectively) and the end of follow-up (OR, 1.17; 95% CI 0.15–9.14; $p = 1.00$; and OR, 2.44; 95% CI 0.21–29.19; $p = 0.45$, respectively) (Table 2).

4.3. Secondary outcomes

A summary of the mean (SD) of cigarette craving, nicotine withdrawal symptoms, affect and quality of life of each group was presented in Table 3. The two-way ANOVA revealed a significant effect of time on cigarette craving ($F_{2,82} = 33.22$, $p < 0.00$), nicotine withdrawal symptoms ($F_{2,82} = 6.08$, $p < 0.00$), positive affect ($F_{2,82} = 3.22$, $p < 0.05$), negative affect ($F_{2,82} = 5.78$, $p < 0.00$) and 3 domains of quality of life (physical functioning: $F_{2,82} = 3.52$, $p < 0.05$; mental health: $F_{2,82} = 4.51$, $p < 0.05$; general health: $F_{2,82} = 5.26$, $p < 0.00$). However, there were no significant effect of intervention and interaction effect (time x intervention).

At the end of treatment, cigarette craving, nicotine withdrawal symptoms and negative affect significantly decrease compared to baseline ($p < 0.00$). In addition, mental health and general health significantly improve compared to baseline ($p < 0.05$).

At the end of follow-up, cigarette craving and nicotine withdrawal symptoms significantly decrease compared to baseline ($p < 0.05$), whereas the positive affect significantly increase compared to baseline ($p < 0.05$). Physical functioning, mental health and general health significantly improve compared to baseline ($p < 0.05$). Participants in the intervention group reported their breathing exercise satisfaction on average of 8.34 ± 1.44.

5. Discussion

The effect of three-part breathing exercise on smoking cessation was evaluated in the present study. The results revealed no significant difference in smoking abstinence rate between the three-part breathing exercise and control group. In addition, participants demonstrated significant pre-post improvement in cigarette cravings, nicotine withdrawal symptoms, affect, and quality of life within each group. However, there was no significant different between the two groups.

The current study found no significant effect of three-part breathing exercise on cigarette craving, nicotine withdrawal symptoms and affect at the end of treatment and the end of follow-up. Our findings are inconsistent with previous study which found that breathing exercise significantly reduced negative affect after practice (Klinsophon et al., 2020). The discrepancy in findings may be due to time to assess the negative affect. In this study, negative affect was assessed at 3-months and 6-months follow-up while the previous study assessed the negative affect immediately after practiced breathing exercise (Klinsophon et al., 2020). This possibility supported by previous research which found the positive effect of yogic breathing exercise on cigarette craving after it was practiced and there was no such a positive effect at 24-h follow-up (Shahab et al., 2013). Moreover, in the real world situation,

Table 1
Characteristic of participants (n = 43).

Variable	Mean (SD)		*p*-value
	Control group (N = 23)	Intervention group (N = 20)	
Age (years)	37.2 (12.2)	36.6 (10.9)	0.87
Gender (Male), No.(%)	23 (100%)	20 (100%)	
Marital status, No.(%)			0.69
Single	5 (21.7)	8 (40.0)	
Married	18 (73.8)	9 (45.0)	
Divorce	0 (0.0)	3 (15.0)	
Education level, No. (%)			0.69
Primary School	6 (26.1)	4 (20.0)	
Secondary School	17 (73.9)	10 (50.0)	
Bachelor's degree	0 (0.0)	6 (30.0)	
Nicotine dependence score (0–10)	3.2 (1.5)	3.2 (1.4)	0.97
Number of cigarette/day	10.5 (5.8)	9.5 (6.3)	0.60
Years smoking continuously (years)	14.5 (9.0)	13.5 (6.6)	0.68
Previous quit attempts (Yes), No. (%)	15 (65.2)	18 (90.0)	0.08
Score of intention to quit (0–10)	7.8 (2.0)	8.1 (1.7)	0.65

Table 2
Smoking abstinence rate by Treatment Group.

Variable	Control (N=23)	Intervention (N=20)	Odds ratio	Confidence interval	*p*-value
End of treatment					
-7-point prevalence abstinence	2/23 (8.7%)	3/20 (15%)	1.86	0.28-12.39	0.65
- Continuous abstinence	1/23(4.4%)	3/20 (15%)	3.88	0.37-40.71	0.32
End of Follow-up					
-7-point prevalence abstinence	2/23 (8.7%)	2/20 (10%)	1.17	0.15-9.14	1.00
- Continuous abstinence	1/23 (4.4%)	2/20 (10%)	2.44	0.21-29.19	0.45

Table 3
Mean and SD of average cigarette craving, nicotine withdrawal symptoms, affect and quality of life in the intervention and control group.

Variable	Mean (SD)					
	Control (N=23)			Intervention (N=20)		
	Baseline	End of treatment	End of follow-up	Baseline	End of treatment	End of follow-up
Cigarette craving	4.2 (1.4)	2.4 (1.8)	3.2 (2.0)	4.2 (1.3)	2.6 (2.0)	3.0 (1.8)
Nicotine withdrawal symptoms	10.7 (3.2)	9.3 (3.4)	9.7 (2.9)	10.8 (3.5)	9.2 (3.5)	9.8 (3.7)
Affect						
- Positive	35.4 (6.8)	36.9 (7.0)	37.2 (6.5)	33.7 (6.9)	35.8 (9.0)	36.4 (8.1)
- Negative	20.5 (5.9)	17.7 (6.2)	19.3 (6.4)	19.95 (6.1)	18.6 (6.4)	19.1 (6.6)
Quality of life						
- Physical functioning	81.1 (17.3)	81.7 (18.2)	86.3 (14.5)	80.0 (19.3)	86.5 (17.0)	87.8 (17.6)
- Mental health	71.1 (15.0)	75.5 (13.2)	77.2 (12.3)	67.0 (15.5)	73.2 (18.2)	73.0 (14.7)
- General health	60.4 (23.0)	67.0 (20.3)	66.3 (19.2)	54.3 (19.5)	64.5 (19.6)	66.0 (20.7)

participants may face with smoking related-cue such as cigarette smoke, cigarette ashtrays and smoking people. Smoking related-cues could attenuate the effect of breathing exercise on cigarette craving, nicotine withdrawal symptoms and affect. It can be suggested that assessment of these symptoms should be made immediately after practiced breathing exercise. Our study demonstrated that three-part breathing exercise has no significant effect on cigarette craving; on the contrary, it was found significantly reduced after performed yogic breathing exercise (which included a combination of alternate nostril breathing and three-part breathing) in previous study (Shahab et al., 2013). The inconsistent result may be related to the different in breathing method. Combination between alternative nostril breathing and three-part breathing may be more effective than three-part breathing alone.

The present study found no significant effect of three-part breathing exercise on abstinence rate at the end of treatment (12 week) and the end of follow-up (24 week). Our finding is inconsistence with one previous study (Bock et al., 2012) which evaluated the effect of yoga on smoking cessation in women. The result revealed yoga which incorporates breathing, meditation and bodily exercise significantly increased a 7-day point-prevalence abstinence rate (7 PPA) at the end of treatment (8 week) compared to control group. The continuous abstinence rate at 6 months (week 24) of our study was 10% which was lower than a previous study showing the abstinence rate of participants who practiced breathing exercise regularly at home to be 21% at 6-month follow-up (Kochupillai et al., 2005). This may result from the method of smoking status assessment. The previous study used questionnaire to record the pattern and amount of their tobacco consumption without biochemical verification (Kochupillai et al., 2005).

However, evidence from systematic review showed self-reports overestimated smoking abstinence rate (Connor Gorber et al., 2009). Using of biochemical verification (e.g., carbon monoxide level, cotinine level) considered essential to validate self-report smoking status.

At the end of follow-up, participants in the intervention group exhibited a 5.6% continuous abstinence rate greater than the control group (10% VS 4.4%, respectively). The difference of 5.6% continuous abstinence rate at 24 weeks may consider clinically relevant. National and international guidelines have accepted that effect of 4% are clinically significant (West 2007). Small but robust effects of treatments that aid smoking cessation are clinically significant because the health gains from quit smoking are very large (West 2007). The level of abstinence rate which increased by breathing exercise is close to many studies. Previous study examined the effect of mailing nicotine patches on smoking cessation. The result revealed that participants who received nicotine patches exhibit 1.8% of 30-day abstinence greater than control group at the 6 months (Cunningham et al., 2016). Another study examined the efficacy of the nicotine patch and gum for adolescents who want to quit smoking. The results showed that participants in the nicotine gum group demonstrated 4% increase in continuous abstinence rate greater than the placebo group at 6 months (Moolchan et al., 2005). Thus, the result of the present study is remarkable as the use of breathing exercise in addition to counseling does not incur any costs and relieves the health system. The possible mechanism to explain why the participants in the intervention group exhibited a 5.6% continuous abstinence rate greater than the control group was the breathing exercise practiced in this study helped with smoking cessation by allowing the participants to cope with some negative affect. For example, the negative affect decreased once they practiced breathing exercise (Klinsophon et al., 2020) and hence delayed smoking. This cycle was repeated and they can finally cease from smoking. However, the relation between breathing exercise and specific mechanism for smoking abstinence should be investigated in the further study. Another reason explained our result including exercise adherence. It was important and associated with treatment outcomes. Participants in the intervention group performed an average of 68.0% of the full breathing exercise program. In addition, three-part breathing exercise provided in the current study was home-based exercise program which was not ensure the participants strictly following prescribed three-part breathing exercises. Participants reported that they performed three-part breathing exercise only 2–5 min/session which was lower than prescribed exercise program (10 min/session). Thus, lower exercise adherence might cause to no significantly increase smoking abstinence rate. The study findings may have been different if the exercise prescription being followed rigorously. Weekly guidance to monitor breathing exercises plus text messages to encourage participants to engage in the breathing exercise may have been insufficient to improve exercise adherence.

This study found no significant effect of three-part breathing exercise on quality of life (physical functioning, mental health, and general health). Participants in both groups demonstrated a significant improvement on physical functioning, mental health, and general health. Our finding is consistent with previous study which evaluated the effect of yoga on smoking cessation (Bock et al., 2012). They also found all participants improving in general health domain but there was no significant difference between yoga group and control group. Another previous study evaluated the impact of smoking cessation therapy on health-related quality of life. They found that participants significantly improved in health-related quality of life after engaging smoking cessation program for 3 months (pharmacotherapy plus brief counseling) (Tomioka et al., 2014). The finding of our study supports that smokers will improve quality of life after engaging in smoking cessation program.

There are four major limitations in this study that could be addressed in future research. First, this study recruited only participants with mild to moderate nicotine dependence. It is possible that the beneficial effects of the breathing exercises might be different in smokers with higher nicotine dependency. Further study with smokers who evidence higher nicotine dependency would be useful to re-assess this possibility. Second, all included participants were male, as is the common characteristic of smokers in Thailand. Data from the World Health Organization reported that only 2.2% of women in Thailand were smokers (World Health Organization 2017b). Female participants should be included for evaluation in the future study. Third, the sample size was small. An a priori sample size estimate indicated that 80 participants (40 per arm) were required. However, only 43 participants were included in this study. A barrier to enrollment was a limited number of participants who were interested in quitting smoking. Based on our sample size ($n = 43$), a power analysis revealed that the study had sufficient power (80%) to detect a medium to large effect (effect size = 0.47) (Portney and Watkins 2008). Further study with greater number of participants is necessary to document the results accurately. Fourth, self-report diary was used to record exercise adherence which may cause recall bias. Other objective measure should be considered to avoid bias associated with self-report in further study.

6. Conclusion

The breathing exercise may not be sufficient to improve abstinence rates over existing smoking cessation program such as counseling. However, improvement of abstinence rate from the three-part breathing exercise considered clinically relevant. Thus, it may be recommended to smokers who were interested in smoking cessation.

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Declaration of competing interest

None.

CRediT authorship contribution statement

Thaniya Klinsophona: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft. **Premtip Thaveeratithama:** Conceptualization, Funding acquisition, Supervision, Writing – review & editing. **Prawit Janwantanakula:** Conceptualization, Supervision, Writing – review & editing.

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